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Patentanmeldung Nr. Patent application No. Demande de brevet n°

99115962.5

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

I.L.C. HATTEN-HECKMAN

DEN HAAG, DEN
THE HAGUE, 24/03/00
LA HAYE, LE

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Blatt 2 der Bescheinigung
Sheet 2 of the certificate
Page 2 de l'attestation

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Method and system for interleaving OCR and ABL for automated mail sorting

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D E S C R I P T I O N

Method and System for Interleaving OCR and ABL for Automated Mail Sorting

1. BACKGROUND OF THE invention

1.1 FIELD OF THE invention

The present invention relates to automated mail sorting. In particular, the present invention relates to method and system for increasing reading rates and lowering error rates by correlation between optical character recognition and address block location techniques.

1.2 DESCRIPTION AND DISADVANTAGES OF PRIOR ART

In automated mail sorting systems the ZIP-code of the destination address on postmail as e.g. a letter or a parcel has to be found. This is usually done by evaluating a digital image of the relevant surface of said piece of mail. This evaluation comprises firstly a procedure called Address Block Location (ABL) which locates a portion of said surface which looks like an address block, or has at least some similarity to it. Then, this portion is selected and passed to an Optical Recogntion System (OCR) system for further processing aimed to extract a ZIP code associated with the destination address of the post mail in order to be able to sorted according said ZIP code by the sorting machine.

In prior art sorting machines electronic programs running on a computer associated with said sorting machine are implemented to perform said ABL and said OCR procedures after a digital picture was taken of the letter's or parcel's relevant surface area.

Such a system is disclosed in WO 98 17 405. The above mentioned procedures are performed sequentially, first ABL, and then OCR.

With a great portion of letters or parcels such systems work quite well, even though there remains an error rate which is always worth to be lowered. Errors are very often due to confusing the destination address with the return address, both written on the surface.

Problems arise when the size of the envelope or that one of the parcel is larger than about DIN B5 as, very often, particularly with parcels further remarks or emblems or stamps or the like are printed on the surface. This can be misleading for such ABL systems because any of such emblem or remarks can be interpreted as a potential address block which is then passed to the OCR system and will be evaluated in vain as a destination address block.

1.3 OBJECTS OF THE invention

Therefore, an object of the present invention is to provide a method and system for increasing reading rates and lowering error rates.

It is another object of the present invention to provide such method and system with increased processing speed.

2. SUMMARY AND ADVANTAGES OF THE invention

These objects of the invention are achieved by the features stated in enclosed independent claims. Further advantageous arrangements and embodiments of the invention are set forth in the respective subclaims.

According to the present invention an improved method and system for automated sorting machines is provided in which a feedback between OCR and ABL takes place. According to a first aspect of the present invention a loose coupling between ABL and OCR is proposed in which the ABL system is asked for a further address block potentially present on the letter's or parcel's surface

when the first one being passed from ABL to OCR yielded that no destination ZIP code could be extracted from it. Thus, a first result of a first OCR procedure is fed back to the ABL system as a trigger signal in order to restart the ABL for providing the OCR system with a second proposal for a destination address block.

Said 'restart ABL' decision is based advantagously on at least one of the following types of information:

The confidence of the actual OCR result, i.e., how good was the first 'address block object' readable. Thus, misleading address blocks as e.g., emblems having the outer shape of an address block, like e.g., a rectangle filled with small symbols or characters can be excluded as a sorting criterion which do actually not comprise neither any ZIP code nor the name of a town.

Further, as the address block contents are known after being processed by the OCR procedure any character information recognized by the OCR can be evaluated with some additional criteria based on general knowledge. If, e.g., the adress block contents comprise a character string like 'Fax', or 'Phone' it can be derived that with a high probability the actual address block represents the return address instead of the destination adress. It is obvious that a lot of further examples for knowledge-based criteria can be found.

Further, ABL confidence is evaluated primarily respecting the position, size, outer shape and inner structure found with the address block.

Further, the sort plan actually loaded on the concerned sorting machine can be visited for gathering more information. It holds information on incoming and outgoing mail, on the town and its ZIP code in which the sorting machine is placed. Thus, assuming the local town in which the machine is installed is a small town,

and the ZIP code evaluated by the first run of the OCR is that one of said small town the probability is high that the found address block is the return address and must thus be rejected as a destination address. The more larger the town, i.e., the city, the less reliable will be such a conclusion as, e.g., in London, UK, many letters are destined to another location in London.

Similarly, postmark information can be evaluated as the stamp visible on a postmark designates the name and/or the ZIP code of the town in which the letter was stamped, which is in most cases the return address town.

Such evaluations can be performed and qualified in various ways independently of the concepts of the present invention. In order to concentrate to the real core of these concepts only a simple and exemplary way is given next below how to qualify these evaluations for a conclusive decision if or if not to accept an address block as a destination adress. To do that some qualifying results - intermediate or final results - are constructed in form of so-called 'confidence values' further referred to as CF-Value (i), i = 1, 2 .. 4, e.g., which are, e.g., normalized between 0 - meaning that no indication can be derived from the evaluated information for having found a destination address block - and 1 - strong indication for having found a destination address. These CF-values (i) represent intermediate results related each to some special information evaluated. In order to get a usable total qualification of an address block all intermediate results must be considered, compared to each other and have to be evaluated including many particular context conditions which in turn are dependent from case to case. Thus, for example by multiplication of all CF(i)-values a CF-total value can be yielded. A CF-total of 1.0 would then mean that the destination address block is found with a probability of nearly 100%.

With reference back to the restart of the ABL system, said step of restarting the ABL system can be of course repeated as long as the available processing time allows it until a destination ZIP

code can be extracted having a high probability of correctness.

The method of the present invention with the characteristics of claim 1 has the advantage, in relation to the method sketched out in the discussion of prior art technique that the error rate is decreased due to said feedback of information from said OCR result to the ABL system. Consequently, the costs for manually sorting are reduced.

In a preferred embodiment of the inventional method as set forth in claim 4 a second preferred aspect of the present invention is disclosed. Here, the ABL system continues to search further address blocks while the OCR system processes one or a plurality of address blocks being passed to it from ABL in a preceding procedure related to the same letter. After being processed by the OCR procedure a summarizing ranking is calculated for each potential address block found. The best rank is given for the most probable destination address block. In this 'tight' coupling of ABL and OCR processes basically the same criteria as mentioned above can be used. However, as a further advantage the ABL and the OCR processes can be performed concurrently except the first ABL process which is the required input for the first run of any OCR procedure. A feedback from ABL to OCR or to an OCR-and-ABL-embedding 'calling' program part can advantageously be provided in order to signalize to the OCR and to said caller program part that no more reliable address blocks can be found. This represents a really bi-directional feedback between both, OCR and ABL which can of course be interleaved as well. Said feedback actions can be passed directly from ABL to OCR or, via said embedding caller program part from which ABL and OCR processes are controlled and invoked, respectively.

Thus, overall processing time is decreased in relation to the work which is done. Further, as all potential address blocks are analyzed the error rate can be further reduced.

3. BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and is not limited by the shape of the figures of the accompanying drawings in which:

Fig. 1 is a schematic representation of a block diagram showing the essential steps and the control flow of the method according to the first aspect (loose coupling) of the invention,

Fig. 2 is a schematic representation of a block diagram showing the essential steps and the control flow of the method according to the second aspect (tight coupling) of the invention, and

Fig. 3 is a rough sketch of an envelope front side which is subjected to the method according to the first and second aspect of the invention.

4. DESCRIPTION OF THE PREFERRED EMBODIMENT

With general reference to the figures and with special reference now to Fig. 1 the essential steps of the method according to the invention are described next below.

It is assumed that a large size letter is subjected to the automated sorting machine having implemented a program performing the inventional method. The letter is destined to an address having the ZIP code of Munich, Germany and having a return address with the ZIP code of Stuttgart, Germany. Both respective address blocks are present on the letter, but, exemplarily, both blocks are nearly equal in size and - complicating the case - the destination address block is placed at an unusual location at the left lower corner of the envelope. Further, the return address block comprises the words: 'please notify' and 'FAX 0711-89898989, z.H., Hr. Maier'. It is assumed further that the

postmark information discloses a ZIP code relating to Stuttgart as well, and that a remark

ATTENTION !
HANDLE
WITH
CARE

is visible at a location at which usually the destination address is found.

In a first step 110 the letter is subjected to the initial ABL procedure, step 110. As the remark

ATTENTION !
HANDLE
WITH
CARE

has nearly the outer shape of a rectangle and is found on the usual location of the destination address block the ABL processing will offer that remark first to the OCR procedure, steps 110 and 120, Yes branch. The pattern is thus processed by OCR. As 100 % of the characters comprising the pattern were recognized, the pure OCR quality is qualified as very well. As, however, the remark does not comprise any ZIP code no good confidence rating, in form of the above mentioned confidence value CF-Value (1), normalized between 0 (no indication for having found a destination address block) and 1 (strong indication for having found a destination address), is assigned to it, step 130.

It should be noted that by order of sequence in which they are mentioned in the text such CF-values are denoted from CF(1) to CF(4). Thus, CF(1) would be somewhere around 0.3 . It is obvious that the remark cannot yet be excluded as a destination address block as it could be that the ZIP code was just forgotten to be printed on the letter and the word 'CARE' could be a name of a town as well.

Then, in a step 140, the confidence of an ABL result relating to said current address block just been localized is calculated. Thus, a CF(2) value is constructed which reflects e.g., the location of the address block relative to other locations of the surface area of the letter. Here, a high value is assigned for locations being the usual ones for the placing of the destination address block, as e.g., in the central area of a parcel cover, or, the left-central or right-central position on a standard DIN B5 letter. Low values, however, are assigned for extraordinary locations.

Further the size and the outer shape and the inner structure of the address block found is evaluated by the ABL system or by an appended program invoked from a suited location in the program. Thus, in the case depicted in fig. 3 a quite high value component CF(2)1 is assigned for the location itself as it is quite central, further the outer shape ressembling a rectangle having straight, horizontal inner line structures yields a high value component CF(2)2 as well, and the size being not extra-ordinary for a destination address block leading to a quite high value component CF(2)3 as well, thus yielding a CF(2) total of around 0.8 , when the components are aggregated into one resulting value.

Then, in a next step 150, the actually loaded sort plan is checked which yields that there would be a high probability for Stuttgart to be mentioned in a return address which is however, not yet found. As e.g., 'CARE' is the most probable town name in the adress block found by the ABL it is seen that CARE does not coincide with Stuttgart and it is decided that the current address block can still be the destination address block with a forgotten ZIP-code. In conclusion, a balanced value of e.g., 0.5 is assigned as a CF(3) value.

Then, in a step 160, the postmark information is checked by ABL and OCR. It is assumed to reveal Stuttgart and a respective ZIP code as town where the letter was stamped. Thus, the information

gathered in conjunction with step 150 is further affirmed, and the same value of 0.5 is assigned as CF(4) value.

Then, advantageously, a cross-check of a table comprising towns and their respective ZIP code can be performed in order to see, if 'CARE' is the name of a town in Germany or within a region in Europe, or worldwide, respectively. It is assumed that the result is negative, a town 'CARE' is unknown. Also, optionally, a cross-check of expressions often found in warnings or further remarks written on letters or parcels is performed which would of course comprise the text pattern 'handle with care'.

Then, a comprehensive intermediate conclusion is undertaken, primarily respecting the fact if a ZIP code could be extracted from the processed address block. It should be understood that, generally, there might be respected the results found in steps 140, 150, 160, as well, for example in cases in which the OCR result is quite ambiguous, when e.g., the ZIP code of the town has such a large distance to the name of the town that only the town name is recognized as a part of the current address block. This can then in turn be taken as a trigger for restarting the ABL system for locating the missing ZIP-code directly and feeding it seperately to the OCR system as an annexe to the address block currently being processed.

Thus, back to the case depicted in fig. 3 and explained in fig. 1 it is decided in a decision 170 that a further address block is asked for from the ABL system without performing a particular complex CF-total calculation as depicted in step 180 what will be done and described with the next address block, however. Thus, a direct feedback step happens from OCR to ABL, and ABL is restarted via the NO-branch of step 170.

Then, in a second run of the ABL the address block depicted in the upper left corner of the large size letter which contains the return address is proposed by the ABL system and is input to the OCR, steps 110, 120.

Then steps 130 to 160 are repeated according to the above described sequence. Other results are derived, however. In particular, performing step 130 is assumed to be well readable, and, additionally a ZIP code can be extracted. Further, a text string 'PLEASE NOTIFY' and another one, namely, 'FAX' followed by a number is extracted from the OCR procedure. As mentioned above this is interpreted as an argument indicating that a return address is found instead of the destination address. Thus, in summary, a low CF(1) value of e.g., 0.1 is assigned to said second address block indicating that the probability is high that the found address is not the destination address.

Step 140 yields a balanced CF(2) value of around 0.5 is assigned as the position is extraordinary, the size, however is normal, and the inner structure and outer shape is the expected one of an address block.

Performing step 150 yields a relatively low CF(3) value of e.g., 0.3, as the sort plan reveals the same ZIP code, i.e., that one of the town in which the letter is sorted, as indicated on the second address block.

Then, in step 160 the postmark information is checked yielding the same value of CF(4) = 0.3 as the letter was stamped in Stuttgart, which is indicated on the actually found address block. Thus, steps 150 and 160 yield a high probability that the found address block is the return address and not the desired destination address.

Decision 170 is then left via the Yes-branch as at least a ZIP code could be extracted.

Then, in a step 180 a summarizing calculation of the assigned CF(i) values is performed for calculating a conclusion if, or if not to reject the actually processed address block as a destination address. Generally, this calculation can comprise a plenty of particular algorithms how to process the CF(i) values,

for example a special function which weights the CF(i) values in an appropriate way, or some particular direct exclusion in order to reject the address block from being used as a destination address, as e.g., in case of the presence of a FAX number. Dependent therefrom the CF(i) values are processed. In here, a simple calculation of simply multiplying the calculated CF(i) values is proposed for reasons of simplicity only as this concerns not the actual core of the invention itself.

Thus, it is calculated: 0.1 x 0.5 x 0.3 x 0.3 yielding a CF-total value of 0.0045. This low total value is quite a good indication that the found address block is not the destination adress block. Thus, it is concluded in decision 190 to ask the ABL system for looking for another address block which is more probably the destination address. Thus, a further feedback to ABL takes place which involves a third run of ABL which in turn will find the destination address in the lower left corner of the letter, finally.

Step 130 yields a high CF(1) value as the address block is quite well readable, and a ZIP code, i.e., that one of Munich, Germany can be extracted, and no exclusive text strings could be resolved from OCR in the address contents. Thus, a CF(1) value of 1.0 can be assigned.

Further, step 140 is performed which respects the unusual position in the upper left corner of the letter's envelope, but the good coincidence with an address block concerning size, outer shape and horizontal line structure. Thus, a total CF(2) value of around 0.7 is assigned calculated by an arithmetic, appropriately weighted mean value of the components, for example.

Further, steps 150 and 160 yield a high CF(3), and CF(4) value of both 1.0, as the ZIP code of the sortplan home location and that one of the postmark information do not coincide with the ZIP code found in the currently processed address block.

Thus, decision 170 is left via the YES branch, a summarizing CF-total value of 1.0 x 0.7 x 1.0 x 1.0 = 0.7 is calculated in step 180 and the conclusion of step 190 is that the CF-total value is high enough for proposing a destination ZIP code to the sorting machine as, additionally, no direct exclusive conditions were found which exclude the address block directly from being proposed as a destination address block. Thus, the currently found address block is proposed as the destination address block of the letter and the ZIP code of Munich is output to the sorting machine for sorting the letter into the respective folder designated for Munich, step 200.

Then the sorting procedure has completed, step 210.

With additional reference now to Fig. 2 the second aspect of the present invention disclosing a tight coupling between ABL and OCR processes is described next below.

Here, the ABL system first processes the remark 'ATTENTION ! HANDLE WITH CARE', steps 310, 320. This potential address block is passed to the OCR system for further processing, i.e., for performing the steps described in conjunction of steps 130, 150 and 160 of fig. 1, as it is depicted in step 330 of fig. 2. The way to process the address block is basically the same as that one described above, i.e., CF(i) values are calculated and assigned to the address block found. As reveals from step 340, however, in contrast to the above described procedure, the CF(i) values are collected and saved in dedicated storage area for a ranking made up between further address blocks still to be found during concurrent processing of the ABL system, see the second YES branch leading to the next looking run of the ABL system.

Thus, the ABL system continues to search further address blocks - here, the next block is that one with the return address - while the OCR system may still process the first one. Optionally, a buffer memory is provided for storing data the ABL system has retrieved and which the OCR system is not yet able to process.

As will be appreciated by a person skilled in the art the processes of the ABL and the OCR systems are concurrent in time which represents the tight coupling between them and which yields a great advantage compared to prior art, i.e., of efficiciently using the computational resources present in the automatic sorting machines computer system.

Finally, no more address blocks are found in decision 320. All address blocks present on the letter's surface have now been located by the ABL system. This can be a decisive difference to the embodiment just described above which terminates ABL activity when - deviating from the example given in fig. 3 - an address block is found which is qualified by the embedding calling program as good enough for being accepted as a destination address block. In such a case a further address block might be found later in time which is considered to have a higher probability to be the destination address block than the block having the relatively good probability found before.

After all address blocks were processed by the OCR procedure the embedding program calculates a summarizing ranking covering each potential address block found, step 360. The ranks are compared and the best rank is used as an indication for the most probable destination address block, the ZIP code of which is output for sorting the letter properly, step 370. Then, the sorting procedure has completed, step 380.

In the foregoing specification the invention has been described with reference to two specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention as set forth in the appended claims. The specification and drawings are accordingly to be regarded as illustrative rather than in a restrictive sense.

In particular, the control flow depicted in the drawings should be regarded as illustrative only. Many variations are possible to

achieve the same abstract goals, i.e., providing a feedback from OCR to ABL and/or to run ABL and OCR processes concurrently in time.

Further, a lot of exclusive conditions can be retrieved which exclude an address block from being further processed and treated as a potential destination address block. Into such knowledge-based conditions all general knowledge can be imported which has accumulated in the post offices all over the world. And, finally, it will be appreciated that those conditions will vary from country to country or from continent to continent.

C L A I M S

1. A method for automatic mail sorting in which the surface of a piece of postmail is scanned with an address block locating (ABL) system for locating address blocks which after being located are then analyzed by an optical character recognition (OCR) system, the method being characterized by the step of

   providing a coupling between said address block locating system and said optical character recognition system in which coupling any results from either of said two systems can be fed repeatedly as an input to the respective other system for further processing.

2. The method according to claim 1 in which a loose coupling is provided in which said ABL system is re-started (110) to scan for a further address block if (170) no ZIP code could be extracted by said OCR system from the current address block currently being ananlyzed.

3. The method according to the preceding claim in which at least one of the following types of information is evaluated (130, 140, 150, 160) for a decision to restart (110) said ABL system:
   the confidence of the OCR result relating to said current address block just being analyzed,
   address block contents information,
   the confidence of the ABL result relating to said current address block just been localized,
   data retrievable by a sort plan associated with the site in which the method is run as a program associated with an automated sorting machine,
   postmark information retrievable from a postmark, and
   knowledge-based information being derivable from one of or a combination of said information.

4. The method according to claim 1 in which a tight coupling is provided in which said ABL system continues (320,310) to scan for further potential address blocks after having found (320) at least one potential address block while said address block is processed (130) by said OCR system.

5. The method according to the preceding claim in which a ranking is provided (340) for each of the address blocks being located and/or ananlyzed for finding (360) the most probable destination address block, the ranking being based on at least one of the following types of information:

the confidence of the OCR result relating to each of said address blocks,

address block contents information,

the confidence of the ABL result relating to said current address block just been localized,

data retrievable by a sort plan associated with the site in which the method is performed as a program run associated with an automated sorting machine,

postmark information retrievable from a postmark, and knowledge-based information being derivable from one of or a combination of said types of information.

6. The method according to the preceding claim in which operation of said ABL system and said OCR system is performed at least partly concurrently.

7. A system having computerized means for performing the method according to one of the claims 1 to 6.

8. A program being able to be run on a computer associated with an automated sorting machine, said program being

provided with code portions representing the method according to one of the preceding claims 1 to 6.

9. An automated sorting machine having computer means associated with it using the program according to the preceding claim.

10. A computer program product stored on a computer usable medium comprising computer readable program means for causing a computer to perform the method according to one of the claims 1 to 6.

LIST OF REFERENCE SIGNS

110 to 380 steps of the inventional method

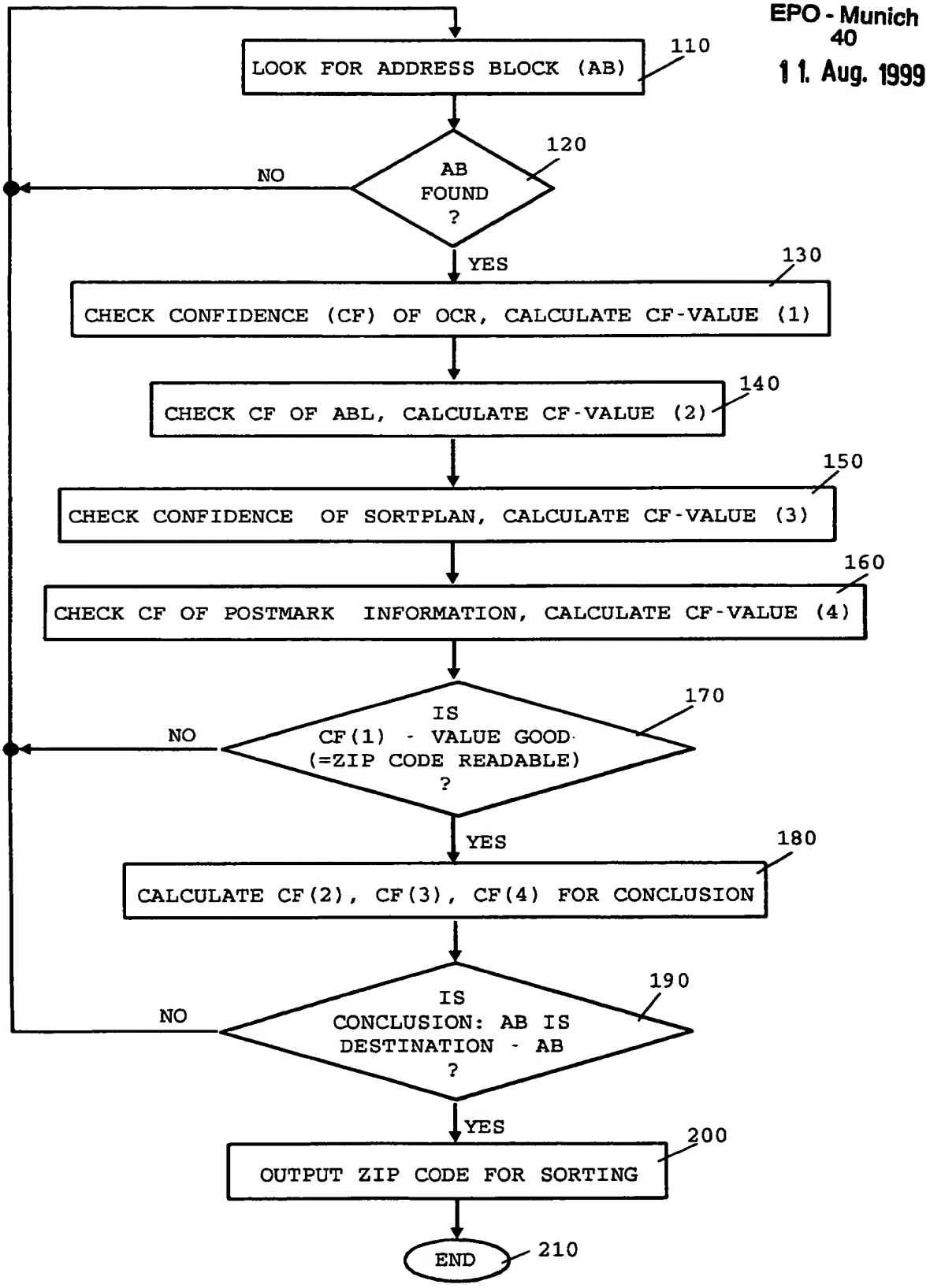

FIG. 1

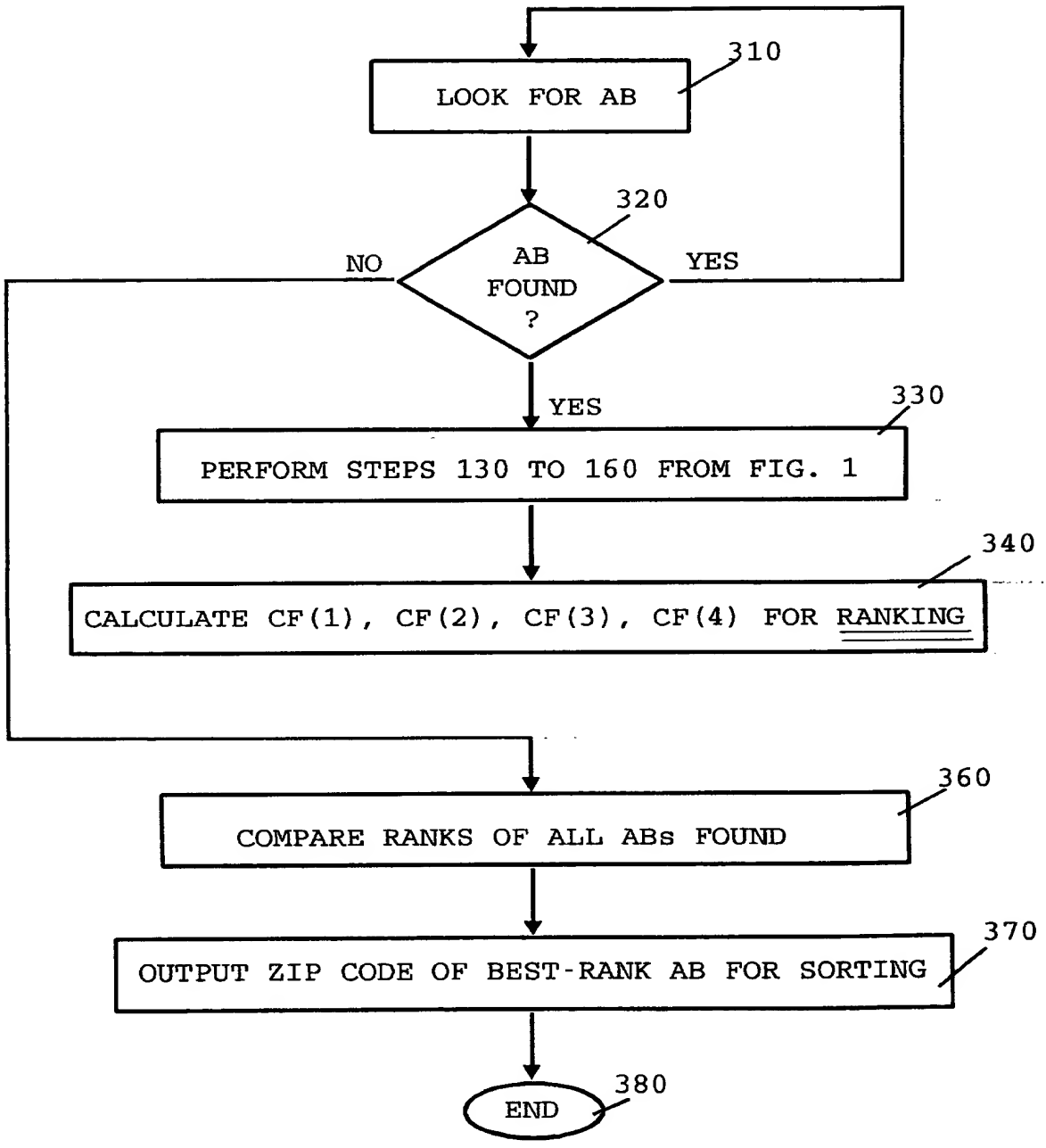
LOOK FOR AB
310
AB FOUND ?
320
NO
YES
YES
PERFORM STEPS 130 TO 160 FROM FIG. 1
330
CALCULATE CF(1), CF(2), CF(3), CF(4) FOR RANKING
340
COMPARE RANKS OF ALL ABs FOUND
360
OUTPUT ZIP CODE OF BEST-RANK AB FOR SORTING
370
END
380

FIG. 2

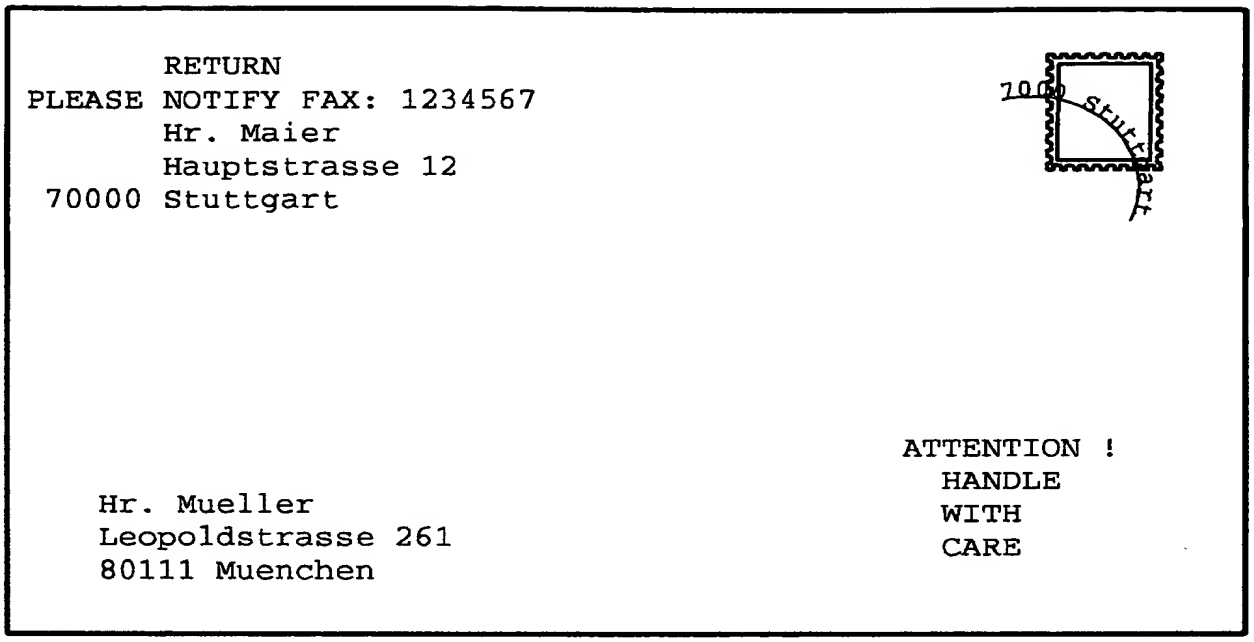
RETURN
PLEASE NOTIFY FAX: 1234567
Hr. Maier
Hauptstrasse 12
70000 Stuttgart
7000 Stuttgart
ATTENTION !
HANDLE
WITH
CARE
Hr. Mueller
Leopoldstrasse 261
80111 Muenchen

FIG. 3

A B S T R A C T

A method and system for automated sorting machines is provided in which a feedback (170, 190) between OCR and ABL takes place. According to a first aspect of the present invention a loose coupling between ABL and OCR is proposed in which the ABL system is asked for a further address block potentially present on the letter's surface when the first one being passed from ABL to OCR yielded that no destination ZIP code could be extracted from it (170).

The confidence of the actual OCR and the ABL result, the address block contents supplemented with some additional criteria based on general knowledge, further, the sort plan actually loaded on the concerned sorting machine and the postmark information found in the stamps of the postmark can advantageously be taken for said ask.

Further, the ABL system can continue to search further address blocks while the OCR system processes one or a plurality of address blocks being passed to it from ABL in a preceding procedure related to the same letter. After being processed by the OCR procedure a summarizing ranking is calculated for each potential address block found. The best rank is given for the most probable destination address block. In this 'tight' coupling of ABL and OCR processes basically the same criteria as mentioned above can be used.

(Fig. 1)